

JOANNA COLE & BRUCE DEGEN

# The Magic School Bus

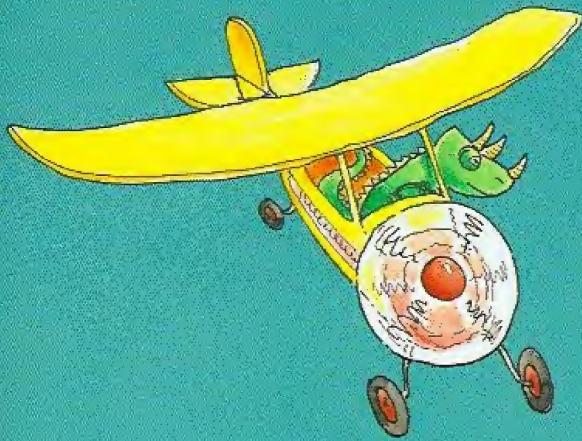
## and the Climate Challenge















In memory of Craig Walker,  
whose brilliant vision for making science exciting  
and funny inspired the Magic School Bus series—  
and both of us.  
He was much loved, and is much missed.  
—J.C. and B.D.



# **The Magic School Bus**

## **and the Climate Challenge**









# The Magic School Bus

## and the Climate Challenge

By Joanna Cole  
Illustrated by Bruce Degen



Scholastic Press / New York





*Many have helped in the making of this book. In particular, our sincere thanks go to Dr. Bill Chameides, Dean and Nicholas Professor of the Environment, Duke University, for his enthusiastic and informed review.*

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The text type was set in 15-point Bookman Light.  
The illustrator used pen and ink, watercolor, color pencil, and gouache for the paintings in this book.  
The text of this book prints on 100% recovered fiber of which 50% is post-consumer waste.



To all our friends in Korea.  
We will never forget your warm and enthusiastic  
welcome to The Magic School Bus, and to us.  
— J.C. and B.D.





ANIMALS OF THE  
ARCTIC

POLAR  
BEARS



by Tim



WHALE by Keesha

SEALS



by Ralphie



WALRUS by Carlos

IN CASE YOU DIDN'T NOTICE,  
MS. FRIZZLE IS THE STRANGEST  
TEACHER IN SCHOOL.

I NOTICED, I NOTICED!

ARCTIC HARE



by Arnold

ARCTIC OWL



by Wanda



ARCTIC FOX  
by Phoebe

JOON

OUR  
WONDERFUL  
WORLD

MOSS

LICHENS





For example, take the day we started to study global warming. We were going to put on a play about Earth and all the changes that are happening. The Friz had brought a book from home, and we were using the pictures to help us paint the scenery.





## WHAT IS GLOBAL WARMING?

by Carlos

Global warming is a rise in the average temperature of the land and water on Earth. Today, the average temperature is more than 1 degree F warmer than it was 100 years ago.



One degree doesn't sound like much, but one small degree has caused big changes already—ice melting, seas rising, and more freak weather!

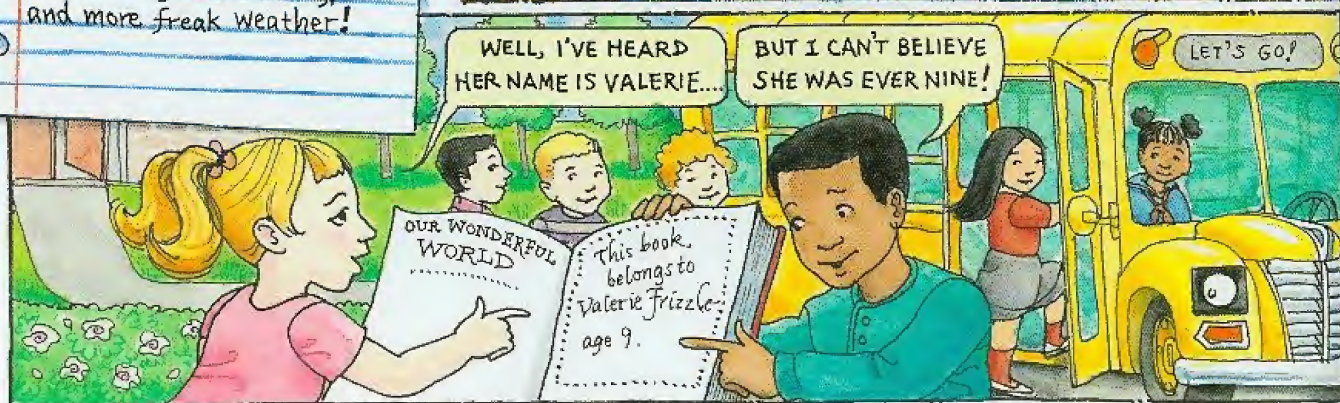
"Ms. Frizzle's book is kind of old," said Tim.

"It came out before things really started heating up."

"I'll go online to get new pictures," said Wanda.

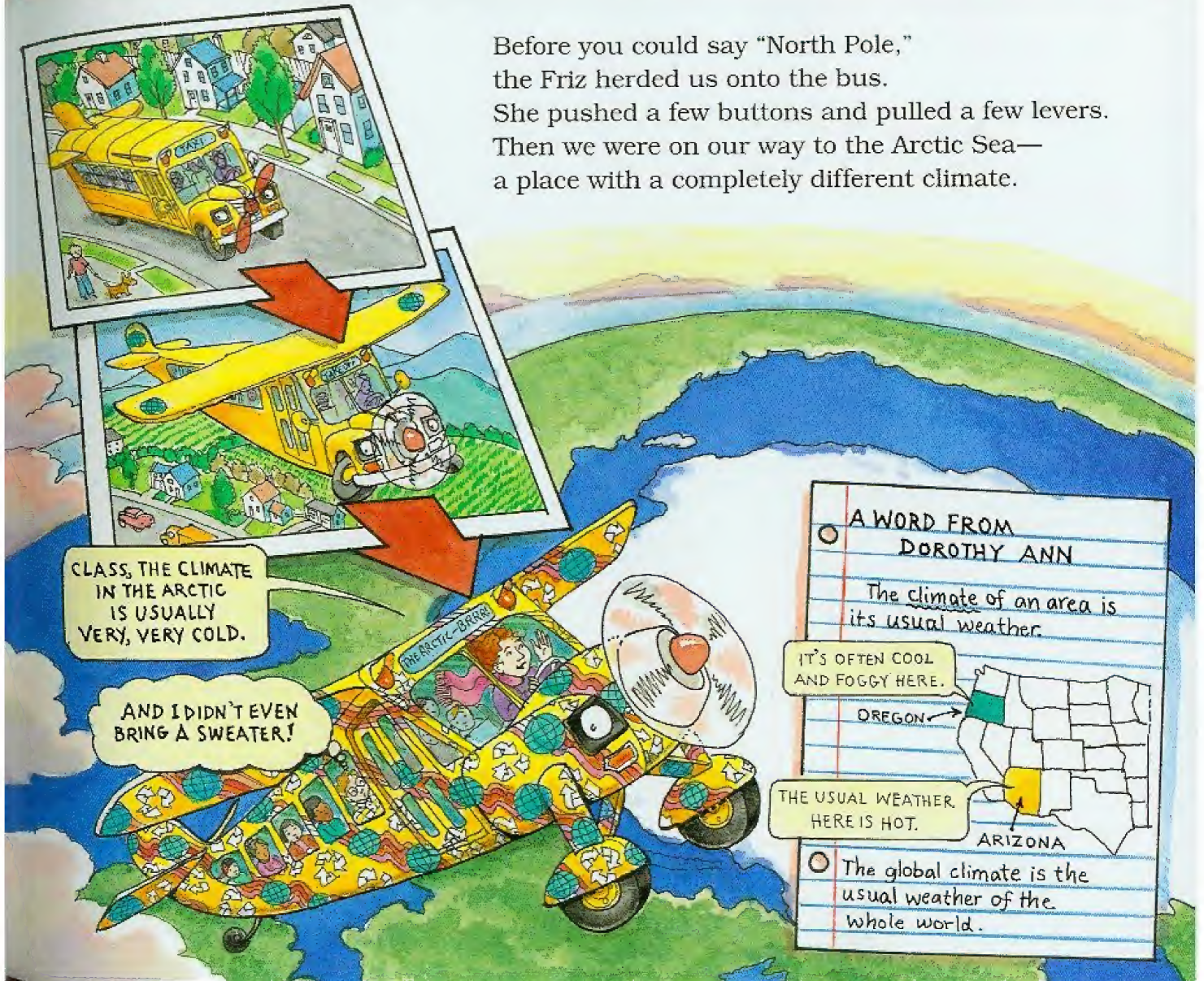
She headed for a computer, but Ms. Frizzle was already out the door. "Come on, class," she called.

"Bring my book, please."





Before you could say "North Pole,"  
the Friz herded us onto the bus.  
She pushed a few buttons and pulled a few levers.  
Then we were on our way to the Arctic Sea—  
a place with a completely different climate.





## MELTDOWN

by Shirley

Melting is happening at the Arctic, Greenland, and the Antarctic.

It's also happening on mountaintops, like the ones in Glacier National Park.

ARCTIC

GLACIER NATIONAL PARK

GREENLAND

ANTARCTIC

BY THE TIME WE GROW UP...

...IT MAY BE CALLED GLACIER-LESS NATIONAL PARK.

BOULDER GLACIER, Glacier National Park

1932

TODAY

When we got there, Dorothy Ann opened Ms. Frizzle's old book.

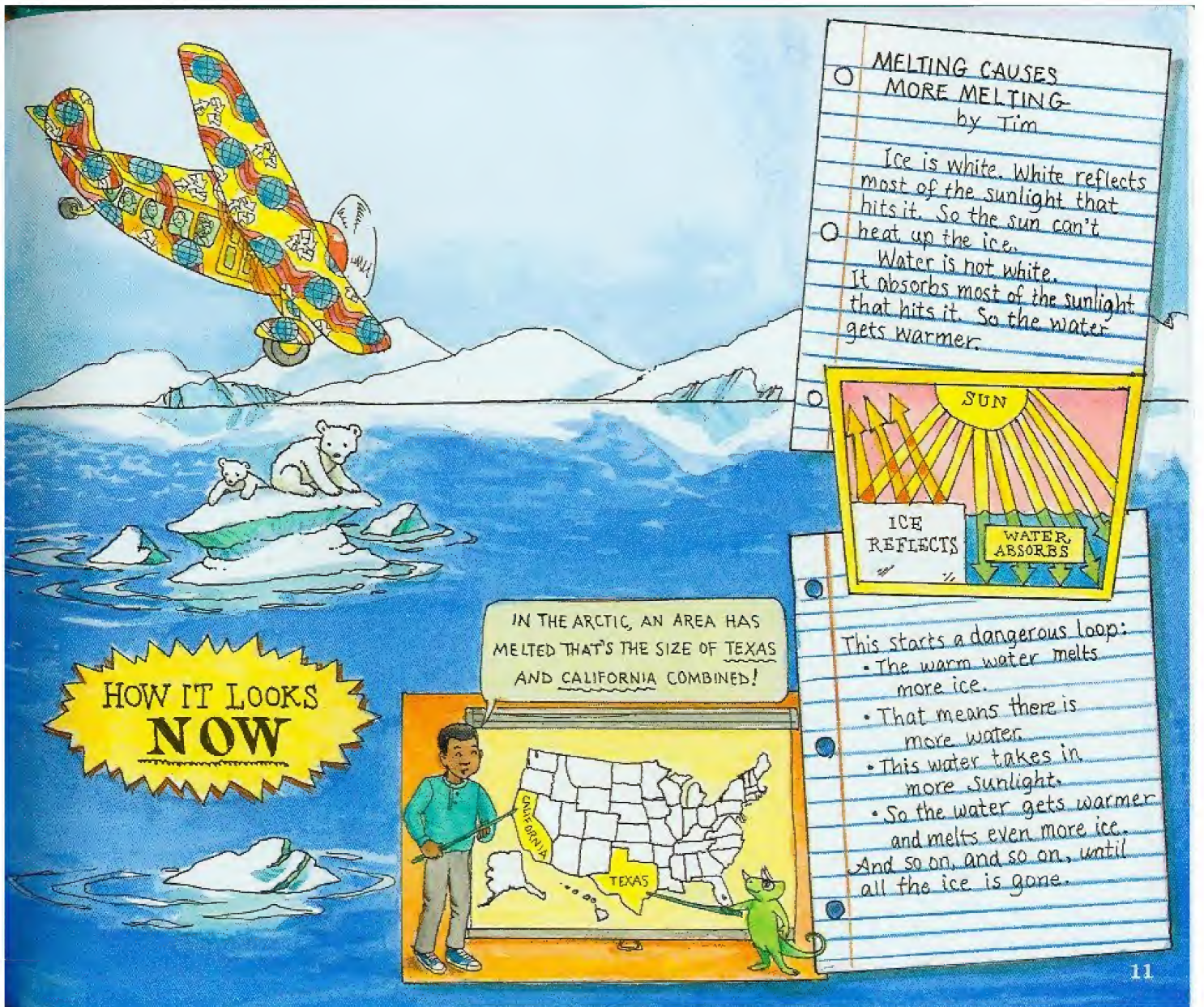
The pictures showed ice everywhere. There was still plenty of ice in the Arctic, but a lot had melted, and more was melting all the time.

THE ARCTIC...

ICE EVERYWHERE!

HOW IT LOOKED **THEN**





## MELTING CAUSES MORE MELTING- by Tim

Ice is white. White reflects most of the sunlight that hits it. So the sun can't heat up the ice.

Water is not white. It absorbs most of the sunlight that hits it. So the water gets warmer.



IN THE ARCTIC, AN AREA HAS MELTED THAT'S THE SIZE OF TEXAS AND CALIFORNIA COMBINED!

This starts a dangerous loop:

- The warm water melts more ice.
- That means there is more water.
- This water takes in more sunlight.
- So the water gets warmer and melts even more ice. And so on, and so on, until all the ice is gone.



Ms. Frizzle steered the bus-plane  
all over the earth.  
We saw changes everywhere.

1. Global warming is melting permafrost,  
soil that is usually frozen.

THERE GOES THE HOUSE!

I'VE HAD IT UP TO HERE  
WITH ALL THIS MUD!



2. It makes some places too dry.

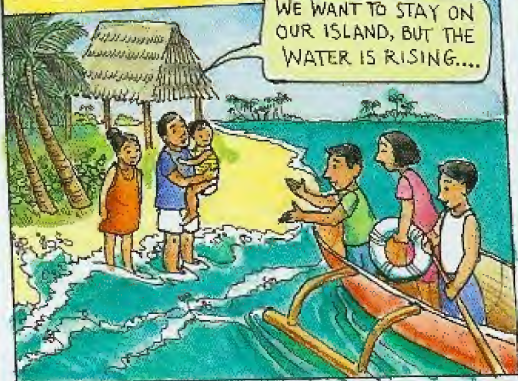
THIS USED TO BE OUR FARM.

NOW IT'S A DESERT.



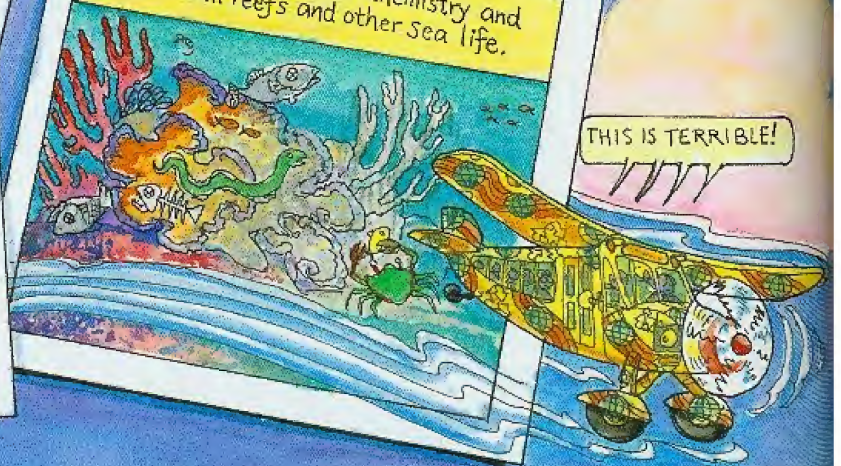
3. It raises the sea level.

WE WANT TO STAY ON  
OUR ISLAND, BUT THE  
WATER IS RISING....



4. It changes the ocean chemistry and  
harms coral reefs and other sea life.

THIS IS TERRIBLE!





5. Warming causes stronger hurricanes and tornadoes...



...and more forest fires...



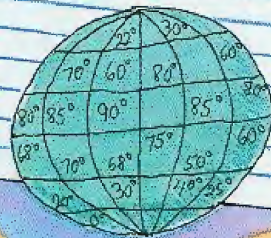
...and bigger blizzards.



GLOBAL WARMING PUTS MORE WATER IN THE AIR IN SOME PLACES. THAT MEANS MORE RAIN, AND, WHEN IT GETS COLD, MORE SNOW!

## WHY IS THERE STILL COLD WEATHER?

by Keesha  
Global warming means that the average temperature of the whole earth is rising.  
Different places still have different weather, but, in most places, there are more hot days and fewer cold days than before.



6. It causes animals and plants to die or to move.

IT'S TOO HOT HERE.

LET'S GO NORTH.

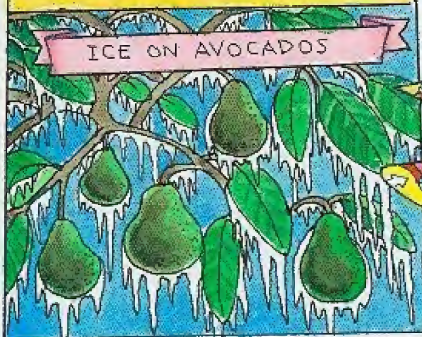


YELLOW-BELLIED MARMOTS



FIRE ANTS

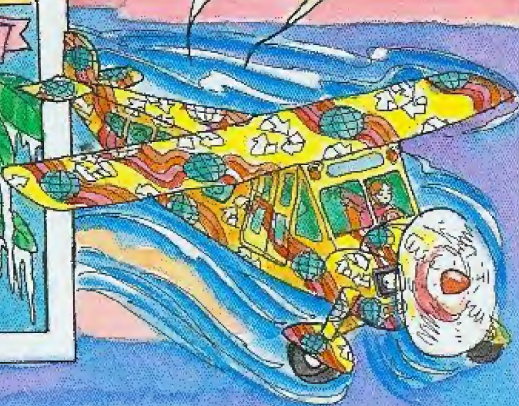
7. Strange weather hurts food crops.



ICE ON AVOCADOS

THAT WHOLE CROP MIGHT BE LOST!

NO AVOCADOS? HOLY GUACAMOLE!





## THE ATMOSPHERE ~ IT'S A GAS

by Phoebe

The earth is surrounded by layers of gases. All this gas is called the atmosphere.

I CALL IT AIR!

## WHAT ARE GASES?

by Arnold

Gases float and fill up any space they occupy.  
A gas is thinner and lighter than a solid or liquid.

ICE



SOLID

WATER



LIQUID

STEAM



GAS

## GASES IN THE ATMOSPHERE

by Molly

Most of the atmosphere is made up of these two gases:

OXYGEN ( $O_2$ )

NITROGEN ( $N_2$ )

"Aren't you children wondering why the earth is getting warmer and warmer?" asked Ms. Frizzle. Actually, we were wondering why she was steering the bus-plane higher and higher.

MS. FRIZZLE, AREN'T THERE NATURAL UPS AND DOWNS IN THE CLIMATE?

YES, BUT THEY DO NOT REALLY EXPLAIN WHAT IS HAPPENING ON THE EARTH TODAY.

DOES ANYTHING EXPLAIN WHAT HAPPENS IN THIS CLASS?





"Most of today's warming is caused by the increasing level of heat-trapping gases in the atmosphere," said the Friz. "Heat-trapping gases are also called greenhouse gases." She had that funny gleam in her eye. We could tell something "interesting" was about to happen.

HEAT-TRAPPING GASES  
ACT LIKE A BLANKET  
FOR THE EARTH.

HOW DOES  
THAT WORK?

GOOD QUESTION,  
RALPHIE.

UH-OH, HERE  
WE GO AGAIN!

SOME GASES TRAP HEAT  
by Ralphie.

Major heat trappers:

Water vapor ( $H_2O$ )

Carbon dioxide ( $CO_2$ )

Methane ( $CH_4$ )

I'VE TRAPPED YOU!

GASES

HEAT

EARTH

I CAN'T  
GET OUT!

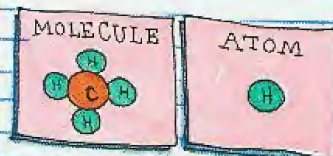




## TINY STUFF MATTERS by Wanda

A molecule is a tiny, tiny bit of matter ~ the stuff the universe is made of.

- Molecules are made up of even tinier bits called atoms.

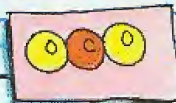


### EXAMPLES OF MOLECULES:

**WATER ( $H_2O$ )**  
two atoms of hydrogen  
one atom of oxygen



**CARBON DIOXIDE ( $CO_2$ )**  
one atom of carbon  
two atoms of oxygen



The Friz was going to show us how the atmosphere could make the earth get warmer. She had flown up so we could look down on the earth. She gave us special microscope-goggles. We could see the gas molecules in the air.

LOOK, I SEE AN OXYGEN MOLECULE.


OXYGEN'S NOT A HEAT-TRAPPING GAS.

THERE ARE CARBON DIOXIDE AND WATER VAPOR.

UH-OH. THOSE ARE HEAT-TRAPPING GASES.

O = OXYGEN  
C = CARBON  
H = HYDROGEN  
N = NITROGEN





CHILDREN, NOTICE HOW  
LIGHT RAYS PASS RIGHT  
THROUGH THE ATMOSPHERE.  
ISN'T IT FUN?

IN MY SCHOOL,  
THERE ARE NO  
TEACHERS LIKE  
MS. FRIZZLE.

CAN I SWITCH  
TO YOUR SCHOOL?

HELP!

HELP!

HELP!

Now our teacher opened the bus door.  
"Catch a sunbeam, kids!" she said,  
cheerfully pushing us out.  
We started sliding toward the earth  
on our own sunbeams.



WHAT IS THE  
"GREENHOUSE EFFECT"?  
by Keesha

A greenhouse uses glass to trap heat to keep the plants warm.

The greenhouse effect is when heat-trapping gases act like the glass in a greenhouse and make the earth warmer.

THE HEAT  
COMES IN,  
BUT IT DOESN'T  
GO OUT.



Our sunbeams landed gently and warmed the soil. As the heat started rising from the earth, we found ourselves going right along with it. "What an opportunity!" shouted the Friz. "We're going to learn about the *greenhouse effect*!"

WE WERE  
LIGHT!

THEN WE  
CHANGED  
INTO HEAT!

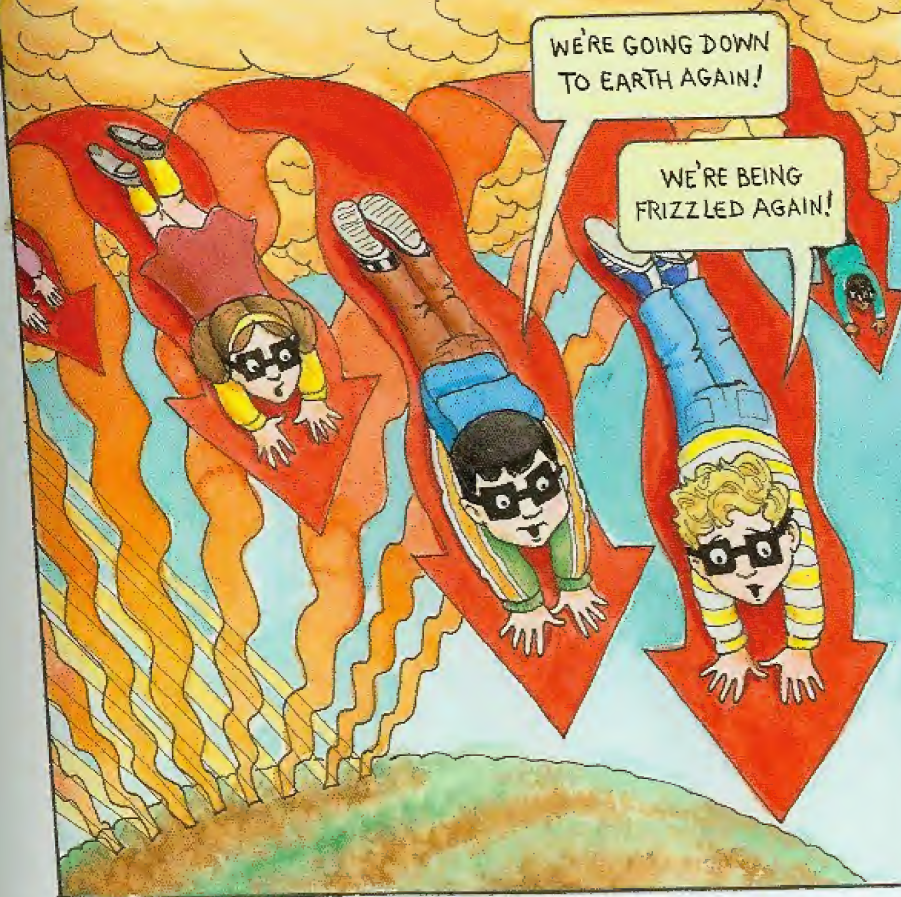
NOW WE'RE  
GOING UP INTO  
THE ATMOSPHERE  
AGAIN!

CLASS, WE'RE  
HOT STUFF!





The greenhouse gases trapped some of the heat. That heat headed back to Earth again. It raised the earth's temperature even higher than before.



## IS THE GREENHOUSE EFFECT BAD?

by Carlos

The greenhouse effect isn't all bad. If there weren't any heat-trapping gases the earth would freeze up.

The natural greenhouse effect keeps the earth at the right temperature for us.

THANK GOODNESS FOR THE NATURAL GREENHOUSE EFFECT!



But when there are too many greenhouse gases, the earth heats up too much. This causes trouble!

I AM ONE HOT DOG!





## WHAT ARE FOSSIL FUELS?

by D.A.

Fossil fuels, such as coal and oil, are made of prehistoric plants that have decayed under the earth.

Some fossil fuels are:

• OIL • COAL • NATURAL GAS

### GREENHOUSE GASES ALSO COME FROM:



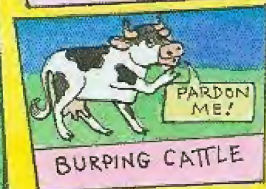
FOREST FIRES



DECAYING LEAVES



ROTTING GARBAGE



BURPING CATTLE

As we went back to Earth, we looked down. Carbon dioxide—CO<sub>2</sub>—was rising into the air. "A lot of extra CO<sub>2</sub> is made when people burn fossil fuels," said the Friz.

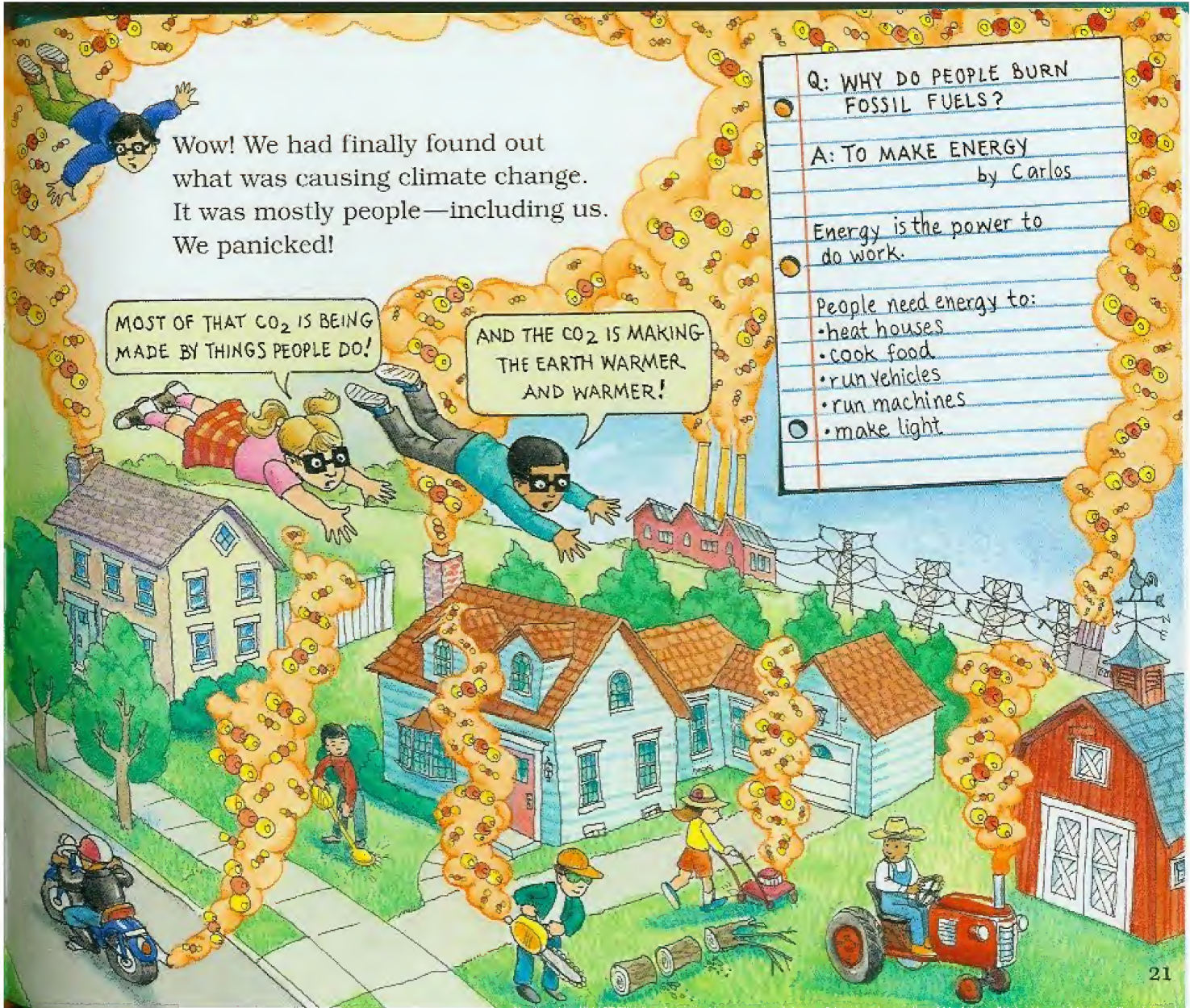
LOOK AT ALL THE CO<sub>2</sub>!

IT'S COMING FROM BUSES, CARS, AND TRUCKS...

...HOUSES AND FACTORIES...

...AND ELECTRIC POWER PLANTS.





Wow! We had finally found out  
what was causing climate change.  
It was mostly people—including us.  
We panicked!

MOST OF THAT CO<sub>2</sub> IS BEING  
MADE BY THINGS PEOPLE DO!

AND THE CO<sub>2</sub> IS MAKING  
THE EARTH WARMER  
AND WARMER!

Q: WHY DO PEOPLE BURN  
FOSSIL FUELS?

A: TO MAKE ENERGY  
by Carlos

Energy is the power to  
do work.

People need energy to:

- heat houses
- cook food
- run vehicles
- run machines
- make light



# WHY IS GLOBAL WARMING HAPPENING NOW?

by Tim

Humans have been on Earth for about 100,000 years. For most of that time, they didn't make enough CO<sub>2</sub> to change the climate.



"How can we stop global warming?" we wailed.

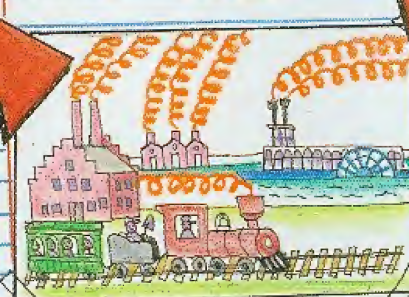
"One way is to use less energy," the Friz said.

"Another way is to use alternative energy!

That's energy made with less—or no—fossil fuels."

Then, about 150 years ago, people invented machines that burned fossil fuel.

Since then, more and more people have been burning more and more fossil fuels.



TODAY THERE IS 30 PERCENT MORE CO<sub>2</sub> IN THE ATMOSPHERE THAN THERE WAS 150 YEARS AGO.

AND MOST OF THE ADDED CO<sub>2</sub> CAME FROM BURNING FOSSIL FUELS.



AND I HAVE TO DRAW MORE AND MORE CO<sub>2</sub> IN THE PICTURES.





Our teacher shoosed us back on the bus-plane.  
Like it or not, we were on our way to see  
some alternative energy.

IF THE FRIZ IS GOING,  
WE HAVE TO GO, TOO.

WE DON'T HAVE AN  
ALTERNATIVE.

ALL ABOARD



## TONS OF CO<sub>2</sub>

by Keesha

Q: How much CO<sub>2</sub> goes into  
the atmosphere for each  
person in the U.S.?

A: Too much!

About 44,000 pounds a year.

That's the same as eight  
hefty hippos per person  
every year!



## REDUCING CO<sub>2</sub> ~

### WHAT'S OUR GOAL?

By the year 2050, Americans  
should have reduced their  
hippos a lot. Instead of

eight hippos,

an American

should emit

less than one

hippo per year.

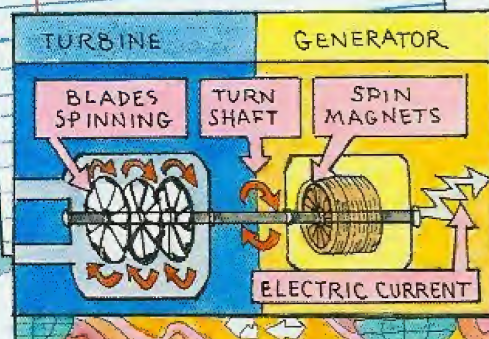




## SPINNING FOR ELECTRICITY by Arnold

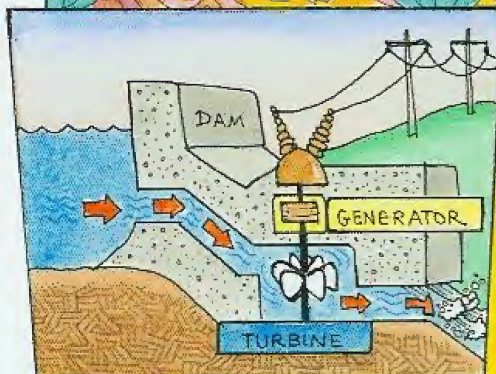
Generators have turbines, or blades, that spin. The spinning movement reacts with magnets to make electric current.

We set out to see generators—machines that make electricity. Most generators burn fossil fuel to spin their turbines and make electricity. Alternative generators make it without fossil fuels.



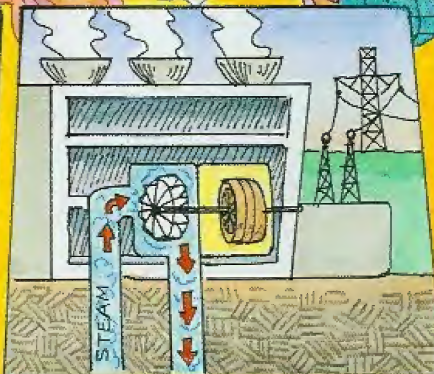
LOOK AT ALL THE THINGS THAT ARE MAKING ELECTRICITY.

AND NO GREENHOUSE GASES.



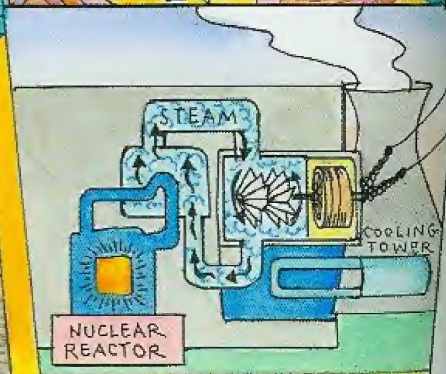
### HYDROELECTRIC PLANT

Movement of water over a dam spins turbines in a generator.



### GEOHERMAL PLANT

Heat from inside the earth makes steam to move turbines.



### NUCLEAR-ELECTRIC PLANT

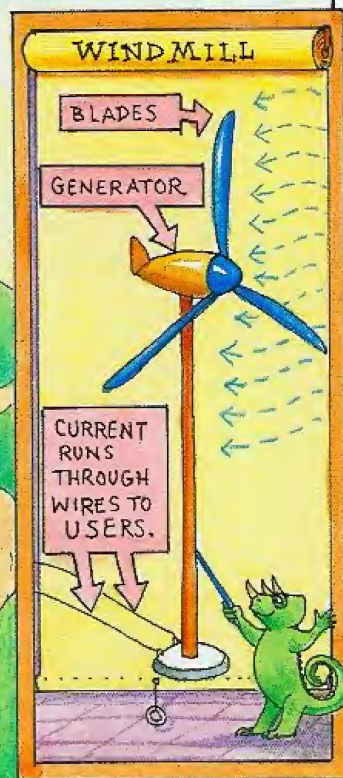
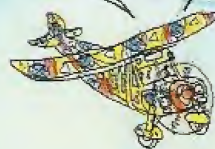
Heat made in nuclear reactors does the same thing.



In the countryside, we saw  
another alternative: windmills.  
The wind turned the blades.  
"Anything that moves has energy," the Friz said.  
"And energy can be made into electricity."

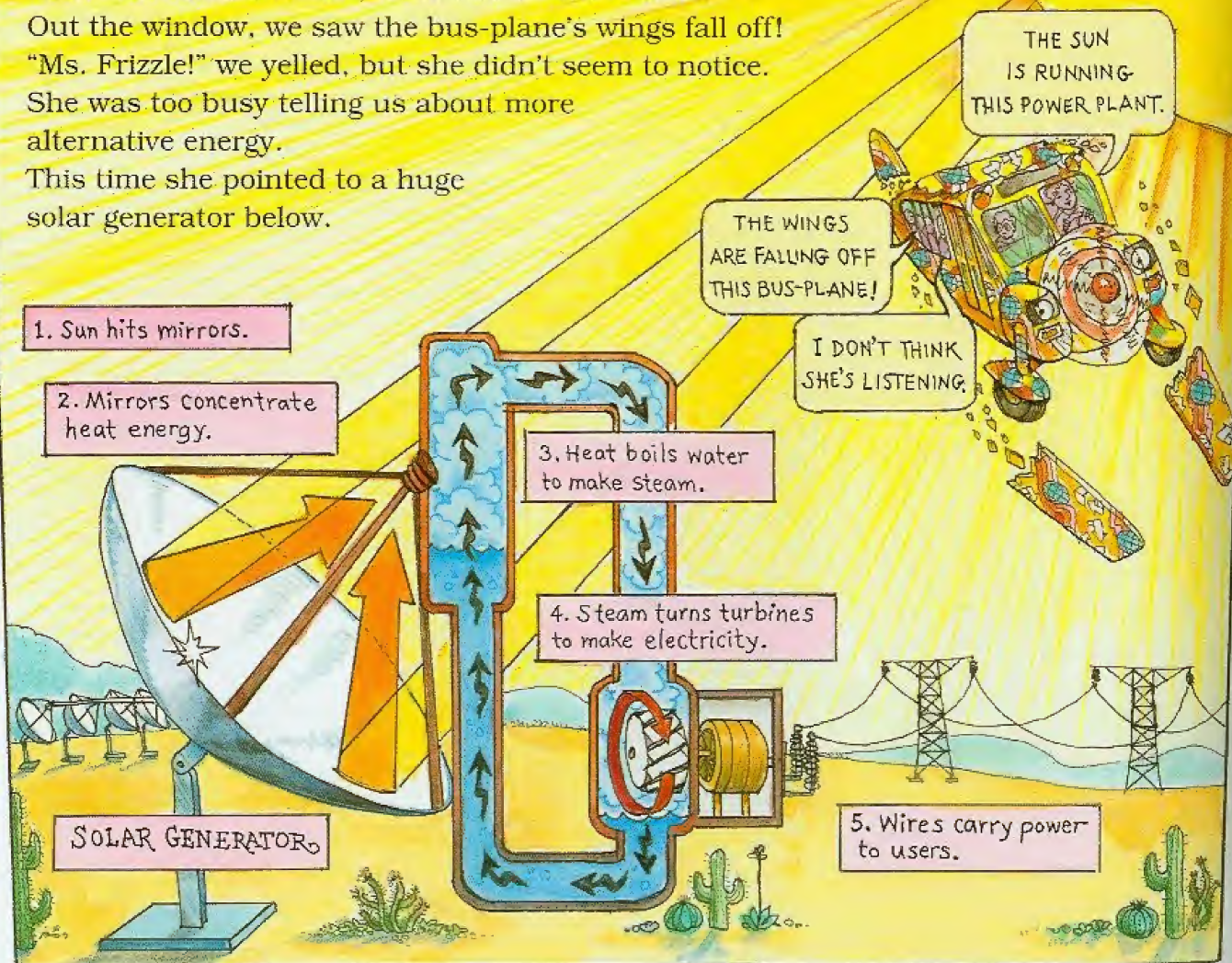
SO WIND POWER  
MAKES  
ELECTRIC POWER!

THAT PUTS A  
WHOLE NEW SPIN  
ON THINGS!





As we flew over a desert, we heard a loud crunch.  
Out the window, we saw the bus-plane's wings fall off!  
"Ms. Frizzle!" we yelled, but she didn't seem to notice.  
She was too busy telling us about more  
alternative energy.  
This time she pointed to a huge  
solar generator below.





The bus made a crash landing.  
Oops, we mean a *splash* landing.  
We were floating in a solar-heated swimming pool.  
Ms. Frizzle kept talking, telling us about solar cells.  
They make energy directly from the sun—  
with no moving parts.

**SOLAR CELLS:**  
**YOU ARE MY SUNSHINE**  
by Ralphie

Solar cells are made of special materials that make electric current when light shines on them.

The cells are microscopic. They can be put on panels or on a thin film.

ROOF COVERED WITH SOLAR FILM MAKES ALL THE ELECTRICITY A FAMILY NEEDS.

CHILDREN,  
DO YOU NOTICE THE MANY  
DEVICES POWERED BY  
SOLAR CELLS?

UM... MS. FRIZZLE,  
DO YOU NOTICE THAT  
THE BUS IS A GIANT  
POOL TOY?

Solar bags  
charge laptops.

HEY!  
NO SPLASHING!

LENNY  
THE  
LIFEGUARD

A solar "briefcase"  
makes energy wherever  
you need it.

Solar panels heat pools...

...and run garden lights.



○ **BIOFUELS:  
ARE THEY BETTER?**  
by D.A.

The plus side: BIOFUEL is made from plants. While it does emit  $\text{CO}_2$  when it burns, it doesn't emit extra  $\text{CO}_2$  because the plants it's made from used up  $\text{CO}_2$  as they grew.

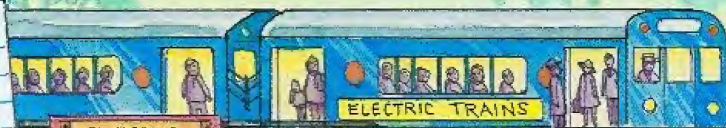
The minus side: Using food crops to make biofuel causes food shortages. And making certain biofuels uses more energy than using fossil fuels.

○ The hopeful side: Scientists are working on biofuels made from algae and grasses.

**A LITTLE CAN DO A LOT**  
If just one person in your house carpooled two days per week, it would keep 220 pounds of  $\text{CO}_2$  out of the air in a year.  
**THAT'S MORE THAN 3 ARNOLDS!**



WHY IS IT ALWAYS ME?  
ER... I MEAN... US.

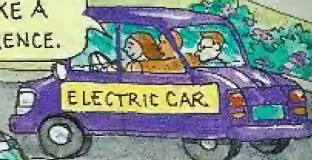


UPTOWN  
WALKERVILLE  
STATION

METRO BIKES  
Rent them here!



IF EVERYONE CARPOOLED,  
IT WOULD MAKE A  
HUGE DIFFERENCE.



SHARE TAXICABS!

The bus stopped being a pool toy,  
so we rode into town.

Everywhere, people were saving energy.  
Instead of driving private cars, many were  
using trains, buses, taxis, and bikes, as  
well as more fuel-efficient vehicles.



Ms. Frizzle pulled a bright green lever. At once the bus morphed into a hybrid vehicle that ran on gasoline and a rechargeable battery.

"Can we please go back to school, Ms. Frizzle?" we begged. "We've been on this bus too long!" For once our teacher listened.

MORE WORDS  
FROM DOROTHY ANN

A HYBRID VEHICLE uses more than one source of energy.

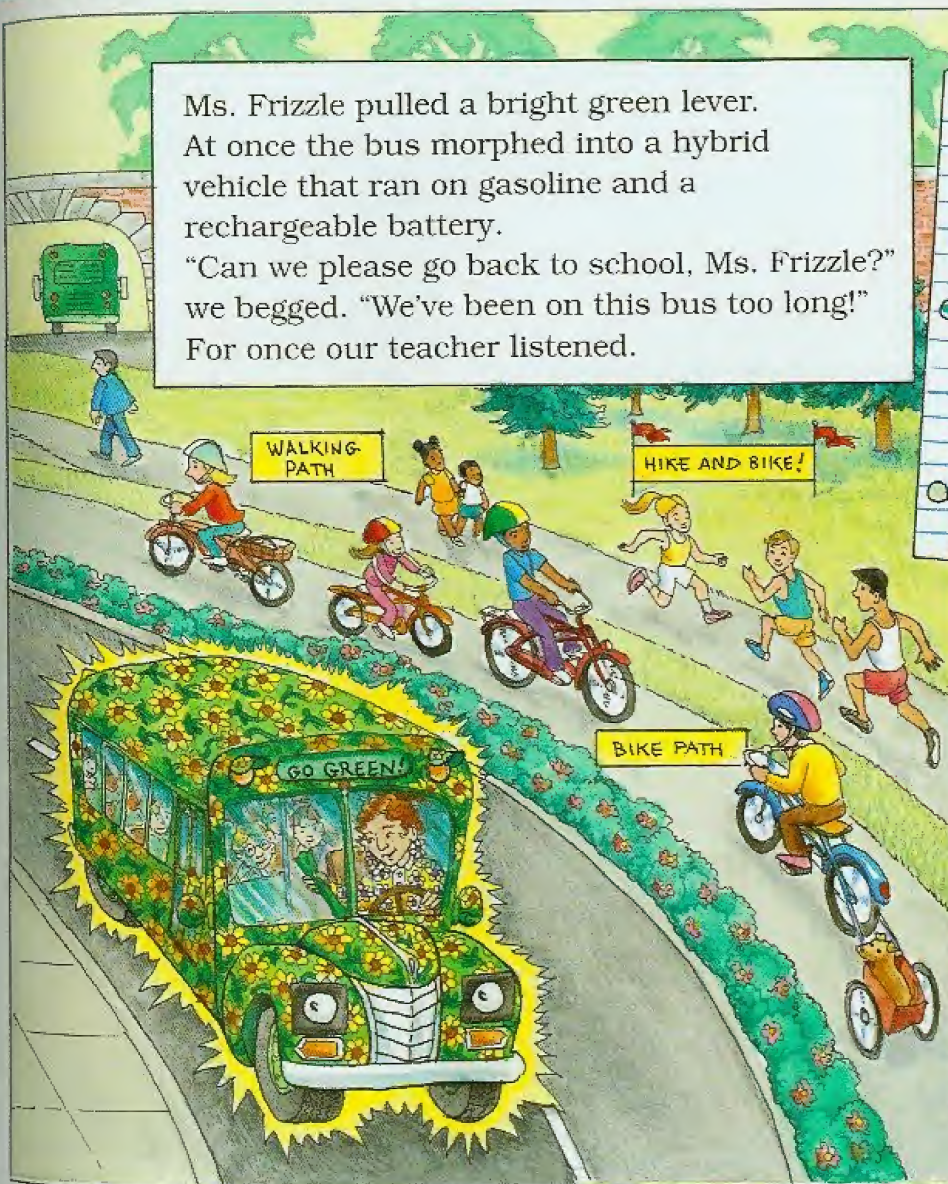
A FUEL-EFFICIENT vehicle uses less fuel to go more miles.

KIDS CAN...  
Take the school bus instead of being driven by a parent.

EVEN AN INEFFICIENT SCHOOL BUS EMITS LESS CO<sub>2</sub> THAN 20 CARS DRIVING KIDS TO SCHOOL.



KIDS CAN... Ask adults to stop letting vehicles idle.





**WORKING TOGETHER!**  
by Wanda

Richer countries can help poorer countries get alternative energy.

That way, less CO<sub>2</sub> will go into the whole earth's atmosphere, and we'll all be better off.

"We're back!" the Friz exclaimed, pulling into the school parking lot. We put our goggles back on, and we saw greenhouse gases all over the place.

THIS IS NOT THE ONLY PLACE THERE'S CO<sub>2</sub>.

RIGHT! IT'S ALL OVER THE EARTH!

MS. FRIZZLE, HOW CAN WE CHANGE THINGS ALL OVER THE EARTH?

CLASS, WE CAN START RIGHT HERE, RIGHT NOW!



We had to start saving energy right away.  
"Conserve, conserve, conserve!" shouted the Friz.  
"Recycle, recycle, recycle!"

I CONSERVE PAPER BY  
WRITING ON THE BACK.

I CONSERVE PAPER, TOO—  
BY NOT DOING MY HOMEWORK!



#### MORE WORDS FROM D.A.

Conserve means  
to avoid waste.

Recycle means  
to treat waste materials so  
they can be used again.

#### RECYCLING SAVES ENERGY by Tim

Making new cans from  
recycled cans uses  
30% less energy than  
making them from new  
aluminum.



#### KIDS CAN...

Recycle cans and bottles!



#### A LITTLE CAN DO A LOT

If your town recycled 2,000 pounds  
of aluminum cans, it would save  
enough energy to heat the typical  
home for 10 years.







We started making changes at our school.  
There was plenty of room for improvement.  
Then we called the mayor of our town.  
Then we wrote to the president.

MAYOR RIVERA?  
MAY OUR TOWN GET A  
WINDMILL, PLEASE?

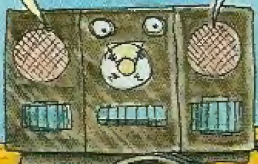
I'M E-MAILING MY  
SENATOR!



MANY ELECTRONICS ARE "ON"  
EVEN WHEN THEY ARE "OFF."

HERE'S A TIP~ GET A POWER STRIP.  
THEN SWITCH EVERYTHING ON AND OFF  
WITH ONE EASY FLIP!

I'M WRITING TO MY  
CLASS BACK HOME.





We told everyone, "Let's cut down on greenhouse gases now!"

- ❖ Don't leave the fridge open too long.
- ❖ Buy Energy Star appliances.

IT'S NOT COOL TO LEAVE THE FRIDGE OPEN!

- ❖ Buy things with less packaging.
- ❖ Buying MORE local produce...

...SAVES ON PACKAGING AND TRANSPORTATION.

- ❖ Use cloth shopping bags.
- ❖ Buy LESS bottled water.



- ❖ Air-dry your laundry.



THE LESS ENERGY YOU USE,  
THE LESS CO<sub>2</sub> GOES INTO THE AIR.

### A LITTLE CAN DO A LOT

If every household in the U.S. switched three lights to compact fluorescent lamps (CFLs), it would reduce as much CO<sub>2</sub> as taking 3.5 million cars off the road.

That's because old incandescent bulbs waste a lot of energy making heat. CFLs use most of their energy making light.





Finally, we had time to put on our play.  
It was about everything we had seen on our trip.  
We showed what global warming was doing to our planet.  
And we told about how people can help.

WARMING ISN'T  
SO GOOD FOR  
OUR FORESTS, EITHER.

IT CAUSES  
DROUGHTS  
AND WILDFIRES...

... AND IT  
BRINGS MORE  
INSECT PESTS.

YUM!  
WE LOVE  
GLOBAL WARMING!

HEY, BUGS!  
STOP EATING  
OUR FORESTS!





THEY GOT THEIR  
WHOLE SCHOOL  
INSPIRED....

THEY GOT OUR  
WHOLE TOWN  
INVOLVED....

Can you believe it?  
A TV station found out about us,  
and we got to be on television!

#### A LITTLE CAN DO A LOT

If every computer and monitor  
in the U.S. were turned off  
at night, we would prevent  
7 million tons of CO<sub>2</sub> from  
going into the atmosphere.



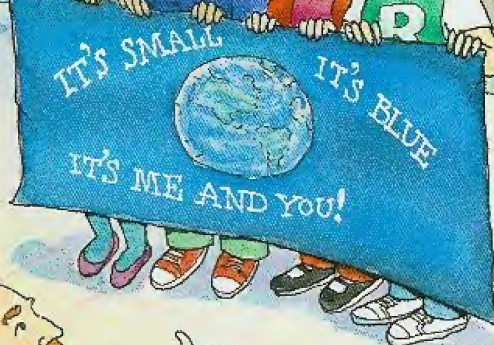
#### KIDS CAN...

put computers into  
sleep or hibernate  
instead of  
screen-saver mode  
**AND** switch off and  
unplug after  
using for the day.



#### KIDS CAN...

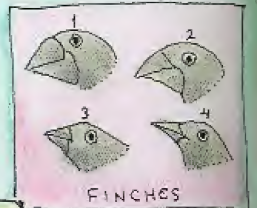
**IN THE SUMMER:** Ask an adult  
to turn the air conditioner  
one degree warmer.  
**IN THE WINTER:** Ask an adult  
to turn the thermostat  
one degree cooler.





As we left school, we asked our teacher,  
"Will the earth really be okay, Ms. Frizzle?"  
"I hope so," said the Friz.  
"Our only chance is to work together—  
every person, every city, every country."

LIGHTS OFF



WE ALL NEED TO TAKE  
CARE OF OUR EARTH!

WE WILL, MS. FRIZZLE!

THERMAL  
WINDOW

A/C OFF or  
HEAT TURNED DOWN

POWER STRIPS  
SWITCHED OFF





## NOW -NOT LATER!

by Phoebe

On our trip, we saw many kinds of alternative energy. The good news is: All of them are available now. The bad news is: Not enough of them are being used yet.



## QUESTIONS FOR MS. FRIZZLE'S CLASS ... an online chat



**Q.** Can a class really go up in the sky and ride sunbeams into the earth?  
from [IvannaNO@once.now](mailto:IvannaNO@once.now)

**A.** According to our research, only Ms. Frizzle's class can do that.  
from [Dorothy.Ann@a.loss.to.explain.net](mailto:Dorothy.Ann@a.loss.to.explain.net)



**Q.** Why are you so worried about global warming? There were warm times in Earth's past, weren't there?  
from [Onceupon@time.now](mailto:Onceupon@time.now)

**A.** In past times, Earth's climate has been cool, cold, warm, and hot. But these changes have happened over millions of years. Animals and plants had time to adjust. The warming we see now has happened in only a few hundred years. We can't adapt that fast.  
from [Ralphey@a.gallop.net](mailto:Ralphey@a.gallop.net)



**Q.** Can a single person really change things?  
from [Juan@atime4change.net](mailto:Juan@atime4change.net)

**A.** One individual can't make a big difference.  
But millions of individuals can!  
from [Phoebe@longlast/together.net](mailto:Phoebe@longlast/together.net)



**Q.** Don't we need bigger help?  
from [a.giant@least?.net](mailto:a.giant@least?.net)

**A.** You're right. We need all the governments of the world to cooperate in solving the climate crisis.  
from [Ms.Fizzle@the.crossroads](mailto:Ms.Fizzle@the.crossroads)



**Q.** Why does Ms. Frizzle always go on such weird class trips?  
from [kids@risk?safety.net](mailto:kids@risk?safety.net)

**A.** That's what I would like to know.  
from [Arnold@home.sweet.home](mailto:Arnold@home.sweet.home)









